U.S. Commerce Department
National Telecommunications and Information Administration
Request for Comment:
Developing a Report on Competition in the Mobile App Ecosystem
Docket No. NTIA–2022–0001; RIN 0660–XC052
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Introduction

In 2007, Google and a consortium of companies from across the mobile industry announced Android and the Open Handset Alliance.[1] Together, we outlined our vision for Android:

> *"Android holds the promise of unprecedented benefits for consumers, developers and manufacturers of mobile services and devices. Handset manufacturers and wireless operators will be free to customize Android in order to bring to market innovative new products faster and at a much lower cost. Developers will have complete access to handset capabilities and tools that will enable them to build more compelling and user-friendly services, bringing the Internet developer model to the mobile space. And consumers worldwide will have access to less expensive mobile devices that feature more compelling services, rich Internet applications and easier-to-use interfaces — ultimately creating a superior mobile experience."*

Over the last fifteen years, that vision has become reality. Android's openness helps power a competitive ecosystem that generates tremendous value for consumers, developers, device makers, telecommunications companies, other technology companies, and the American economy as a whole. In 2020, the Android app economy, including Google Play, helped create nearly 2 million American jobs — from software engineers and developers of mobile applications, to the marketing and human resources teams that support them.[2]

Choice is a cornerstone of the Android ecosystem. Because of Android's openness, more than 1,300 brands have been able to build more than 24,000 different Android devices. Developers

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[1] Industry Leaders Announce Open Platform for Mobile Devices, November 7, 2007 https://www.openhandsetalliance.com/press_110507.html

[2] Written Testimony of Wilson White, Senior Director, Government Affairs and Public Policy, Google LLC Senate Judiciary Committee Subcommittee on Competition Policy, Antitrust, and Consumer Rights, "Antitrust Applied: Examining Competition in App Stores," April 21, 2021 https://www.judiciary.senate.gov/imo/media/doc/Written%20Testimony%20-%20Google%20Wilson%20White%20-%20Senate%20Judiciary%204_21.pdf

are able to distribute their apps in a variety of different ways: across multiple different app stores, through distribution agreements with hardware manufacturers and carriers, and on the web directly. Google Play supports more than 500,000 American developers and enables them to distribute apps to billions of users around the world, manage payments, and secure their data with industry-leading safeguards.

Protecting users' security and privacy is another pillar of the Android ecosystem. Android's security model relies on a defense-in-depth strategy that combines multiple independent layers of security—scanning mobile apps for various threats, frequent security updates, network security, OS isolation, hardware protections, and Google technologies like Safe Browsing—to keep users safe. One of our core safeguards, Google Play Protect, scans 125 billion installed apps across the Android ecosystem every day.

The safest way to get apps and games on an Android device is from one of the ecosystem's many reputable app stores, of which Play is one. On Google Play, we combine automated safeguards like Play Protect with comprehensive developer policies that set the rules of the road for all apps, including Google's apps, that use the store.[3] The policies are publicly accessible[4] and offer detailed guidance about our expectations for developers whose apps we distribute. Our policies prohibit a wide range of obvious bad practices—selling personal and sensitive user data, impersonating another app, running deceptive and disruptive ads—and also require responsible practices like handling all user data securely with modern cryptography (for example, over HTTPS), posting a privacy policy, and providing an in-app disclosure of your data access, collection, use, and sharing.

Transparency and control underpin our approach to privacy on Android. We want to help users make informed decisions about their data and we're constantly improving the tools that enable them to do so. To this end, Android introduced a variety of new transparency features last year including a Privacy Dashboard that shows a timeline of apps' accesses to location, microphone, and camera over the course of 24 hours, prominent indicators on the device's home screen that activate when the device's microphone and camera are in use[5] and a Data safety section on the app-download page in Google Play that shows the data an app collects, why it's collected, whether it's shared with third parties, how it's protected, whether it can be deleted, and more.[6]

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[3] Google Play Developer Policy Center, https://play.google.com/about/developer-content-policy/
[4] Providing a safe and trusted experience for everyone, https://play.google.com/about/developer-content-policy/
[5] What's new in Android Privacy, May 18, 2021 https://android-developers.googleblog.com/2021/05/android-security-and-privacy-recap.html
[6] Get more information about your apps in Google Play, https://blog.google/products/google-play/data-safety/.

In-app data permissions are a good illustration of how we make it easy for users to control their data while also implementing privacy guardrails behind the scenes. With location data, for example, we built an "only this time" option in Android 11 so that users aren't forced to share their location in perpetuity[7] and then in Android 12, gave users a new option of sharing either their approximate or precise location data with an app.[8]

In parallel, we have built technologies that protect user privacy, automatically. We separated developers' ability to access background and foreground location, and then required developers to apply to use background location data at all. Beyond just location data, in Android 11, we began automatically resetting permissions[9] for apps that hadn't been used for an extended period of time. We have since expanded the feature to devices running Android 6 and above and have automatically reset over 5 billion permissions.[10]

Finally, Android has always been a platform that aims to provide everyone with a high quality mobile experience, regardless of income or ability. Today, many Android phones are available for less than $100 and include many features for people with disabilities.[11] For example, we recently added out-of-the-box support for braille displays in Talkback (our screen reader within Android) to improve the quality of refreshable braille,[12] and new Android features and applications for people with hearing loss, deafness, and cognitive difference.[13] Developers also have access to Android tools to assist them in building more accessible apps.[14] Taken together, these tools help make the app ecosystem more accessible for everyone.[15]

It is with this context that Google looks forward to continuing to engage with Android's stakeholders to ensure a robust, open, secure and competitive ecosystem for the future. We

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[7] Safer and More Transparent Access to User Location, Krish Vitaldevara, Director of Product Management Trust & Safety, Google Play, February 19, 2020
https://android-developers.googleblog.com/2020/02/safer-location-access.html
[8] What's new in Android Privacy, May 18, 2021
https://android-developers.googleblog.com/2021/05/android-security-and-privacy-recap.html
[9] Permissions updates in Android 11,
https://developer.android.com/about/versions/11/privacy/permissions#auto-reset
[10] Making permissions auto-reset available to billions more devices, Peter Visontay, Software Engineer; Bessie Jiang, Software Engineer, September 17, 2021
https://android-developers.googleblog.com/2021/09/making-permissions-auto-reset-available.html
[11] Android accessibility overview, https://support.google.com/accessibility/android/answer/6006564?hl=en and https://www.android.com/accessibility/
[12] Making Android more accessible for braille users, Nimer Jaber, Accessibility Analyst, May 19, 2022
https://blog.google/products/android/braille-display-talkback/
[13] Accessibility updates that help tech work for everyone, Ajit Narayanan Software Engineer, Central Accessibility Team & Sharlene Yuan, Product Manager, Android Accessibility, May, 21, 2020
https://blog.google/products/android/accessibility-updates-help-tech-work-everyone/
[14] Build more accessible apps, https://developer.android.com/guide/topics/ui/accessibility
[15] Material Design, Accessibility,
https://material.io/design/usability/accessibility.html#understanding-accessibility (e.g., providing developers with guidance on design optimization for people with low vision, blindness, hearing impairments, cognitive impairments, motor impairments or situational disabilities.

welcome the opportunity to respond to NTIA's request for comment on competition in the mobile application ecosystem. Please find our responses below.

Definitions and Statistics

1. How should we measure whether the app ecosystem is competitive?

As it embarks on this study, it is important that NTIA does not equate the app ecosystem with just the mobile app ecosystem. Users engage with apps to consume content, play games, and communicate with friends across a swath of different connected platforms.

Smartphones are just one of many ways people use apps today. The Disney+ app, for example, is available on smart TVs, gaming consoles, and streaming devices like Roku, in addition to smartphones and tablets.[16] Both Microsoft's Game Pass app[17] and Spotify's app have similar strategies; Spotify even runs on wearables like smartwatches.[18] And these are not outliers: a cross-platform strategy is table stakes for modern media apps because users have come to expect the ability to use them anytime. No doubt this will only become more true over time, as nascent platforms like the metaverse mature.

With that said, the mobile app ecosystem, specifically, is highly competitive and thriving. Over the past decade, there has been extraordinary growth in consumers downloading apps to their mobile devices. In 2011, consumers downloaded about 12 billion apps from Google Play.[19] In 2016, consumers downloaded 55 billion apps per year.[20] By 2021, consumers downloaded about 111 billion apps per year – double the number of downloads per year compared to five years earlier.[21] In addition, in 2021, consumers downloaded 230 billion apps from all app stores—an increase of over 60% from five years ago,[22] and consumers spent $170 billion in app stores, a three-fold increase from five years earlier.[23] The data demonstrate that consumers know how to find and download apps to their mobile devices.

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[16] Disney+ supported devices, https://help.disneyplus.com/csp?id=csp_article_content&article=devices-supported
[17] XBOX Game Pass on Your Favorite Devices, https://www.xbox.com/en-US/xbox-game-pass/supported-devices
[18] Supported devices for Spotify, https://support.spotify.com/us/article/supported-devices-for-spotify/
[19] Google Play About To Pass 15 Billion App Downloads? Pssht! It Did That Weeks Ago, Indgrid Lunden, May 7, 2012, https://techcrunch.com/2012/05/07/google-play-about-to-pass-15-billion-downloads-pssht-it-did-that-weeks-ago/ (stating that Google Play "is seeing about 1 billion downloads of Android apps per month" – or 12 billion per year).
[20] Statista, Annual number of app downloads from the Google Play Store worldwide from 2016 to 2021, https://www.statista.com/statistics/734332/google-play-app-installs-per-year/
[21] Id.
[22] Statista, Number of mobile app downloads worldwide from 2016 to 2021, https://www.statista.com/statistics/271644/worldwide-free-and-paid-mobile-app-store-downloads/
[23] Business of Apps, App Revenue Data (2022), https://www.businessofapps.com/data/app-revenues/

Consumers and developers benefit from the variety of different ways Android users access mobile apps. Google Play is just one of many places users can download Android apps. Most Android devices ship with at least two app stores preinstalled, and consumers can choose to install others as well. Developers, therefore, can choose to distribute their apps across many different stores and directly from their sites. These options should be available on all platforms.

2. Are there any important and specific entities (or categories of entities) such that it would be a mistake to omit—or improperly include—them by defining the "mobile app ecosystem" to focus on mobile devices, such as phones and tablets? a. If so, how should this study be scoped so that it is optimal but feasible? b. For example, should mobile apps offered specifically for enterprise use (*e.g.*, for use by businesses, not for consumers) be considered in this study?

The ways people engage with content across screens and devices is fluid, and games are one of the best examples of this established trend. Given the history of innovation in gaming, it's no surprise they're once again on the cutting edge of a trend in media consumption. As Eric Seufert, a leading mobile analyst explained: "Gaming is not some small, provincial niche. Gaming is the crucible in which these new technologies are honed and perfected and prepared for broader deployment. And not just through technological innovation but through commercial innovation, as well (eg. the Freemium model)."[24]

The facts bear this out. Microsoft's Minecraft, the best selling video game of all time, can be played on 21 different types of devices, including smartphones running Android and OS, and gaming consoles such as Playstations, Xboxes, and Oculus.[25] Phil Spencer, CEO of Microsoft Gaming, has been very upfront about this shift in consumer behavior: "The idea that there are mobile games and then there are PC games and then there are console games, for me, died about seven, eight years ago."[26]

With this in mind, the study should include all major platforms that people use to consume their preferred content, especially PCs and gaming consoles which often share the same business model as mobile app stores. Xbox, for example, charges a fee on sales of digital content just as Google Play and Apple do. It should also be noted that some of the most popular services on Xbox aren't games at all—they're Netflix and YouTube.[27]

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[24] Eric Seufert, March 11, 2022, Twitter https://twitter.com/eric_seufert/status/1502342927284150276
[25] Minecraft extends lead as best-selling game of all time, Shawn Knight, March 18, 2020 https://www.techspot.com/news/85265-minecraft-extends-lead-best-selling-game-all-time.html
[26] Microsoft Acquires Activision Blizzard, Notes on the Acquisition, An Interview With Microsoft Gaming CEO Phil Spence', Stratechery, January 19, 2022 https://stratechery.com/2022/microsoft-acquires-activision-blizzard-notes-on-the-acquisition-an-interview-with-microsoft-gaming-ceo-phil-spencer/
[27] When it comes to Xbox, the X could probably stand for NetfliX, Kyle Orland, June 6, 2017 https://arstechnica.com/gaming/2017/06/the-most-popular-app-on-xbox-isnt-a-game-its-netflix/

Taking a step back, the study should recognize both near and long-term trends regarding content distribution and consumption. Near-term, recent activity in the $180 billion[28] gaming industry—Microsoft's proposed acquisition of Activision Blizzard, in particular—signals a broader trend toward consolidation of titles by the industry's largest players, led by Tencent whose 2021 gaming revenue was $27 billion.[29] Microsoft was clear in their press release that the deal was intended to make its streaming service, Game Pass, "one of the most compelling and diverse lineups of gaming content in the industry."[30] How, and whether, those games remain available outside of Game Pass remains to be seen.

But, Microsoft also alluded to a longer-term trend in their announcement: the development of the metaverse, an entirely new computing platform that Morgan Stanley valued at over $8 trillion in February 2022.[31] Microsoft's CEO Satya Nadella said it plainly: "Gaming is the most dynamic and exciting category in entertainment across all platforms today and will play a key role in the development of metaverse platforms."[32] The metaverse will shape every industry: even Sotheby's Auction House, founded in 1744, is betting on it.[33]

Lastly, we recommend the study examine enterprise apps not just because they represent a sizable market, but also because the distinction between personal and business uses of the same devices and services has become increasingly blurry. This is not a new trend, but it has been accelerated because of the shift to remote work during the pandemic.

3. Apps are not all the same. For example, some have different technical features and capabilities (*e.g.*, location-based apps compared to messaging apps), while others are bound by specific regulatory guardrails (*e.g.*, banking apps or children's apps). In the context of framing competitiveness within the ecosystem, how should we categorize types of apps so that they are grouped by distinguishable barriers and other significant factors? Are there ways to best categorize or segment the market to diagnose specific market barriers, such as those that could impact app developers, or consumers. a.

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[28] The Games Market and Beyond in 2021: The Year in Numbers, NewZoo, https://newzoo.com/insights/articles/the-games-market-in-2021-the-year-in-numbers-esports-cloud-gaming

[29] Tencent games revenues rose to $27 billion in 2021, James Batchelor, March 24, 2022 https://www.gamesindustry.biz/articles/2022-03-24-tencent-games-revenues-rose-to-usd27-billion-in-2021

[30] Microsoft to acquire Activision Blizzard to bring the joy and community of gaming to everyone, across every device, January 18, 2022 https://news.microsoft.com/2022/01/18/microsoft-to-acquire-activision-blizzard-to-bring-the-joy-and-community-of-gaming-to-everyone-across-every-device/

[31] Metaverse: More Evolutionary than Revolutionary?, February 23, 2022, https://www.morganstanley.com/ideas/metaverse-investing

[32] Microsoft to acquire Activision Blizzard to bring the joy and community of gaming to everyone, across every device, January 18, 2022 https://news.microsoft.com/2022/01/18/microsoft-to-acquire-activision-blizzard-to-bring-the-joy-and-community-of-gaming-to-everyone-across-every-device/

[33] Sotheby's Launches an NFT-Only Marketplace, Shanti Escalante-De Mattei, October 19, 2021 https://www.artnews.com/art-news/market/sotheby-metaverse-nft-only-marketplace-1234607430/

Should distinctions be made based on type of content and app functionality b. Should distinctions be made based on the level of hardware or operating system integration required for the app to function? For example, categories might include apps that access location data, special-purpose hardware (*e.g.*, near field communications), secure elements for payment, or other credentials. c. Should a distinction be made for apps that are the primary way (or the only way) the app provider interacts with users, as opposed to apps that are an extension of an existing digital or physical business? Do app-based businesses face different competitive constraints than businesses that have a brand and presence outside of mobile apps?

The study has the challenge of accounting *both* for how apps are categorized and regulated today, and the fact that they're evolving to become increasingly difficult to categorize at all. For instance, the study should recognize existing regulations and other long standing industry-standards, like content ratings. Games, however, are starting to defy categorization. They may be viewed as social or messaging platforms because users can interact with their friends within the game, or marketplaces, as users buy hundreds of millions of dollars worth of digital goods within apps.[34] In other words: what may be categorized as a game today, could be its own, self-contained ecosystem in the not-distant future.

From a technical standpoint, developers need to account for an ecosystem that is constantly evolving. That's why Google has made it a priority to ensure their apps function across different devices and do so safely. We provide technical resources[35] about device compatibility, invest in Android's ability to update apps more quickly and easily, and require that Google Play developers implement the most recent version of the Android API level to ensure apps have access to new features and security updates.[36]

The ecosystem will continue to develop, but some goals should remain unchanged. Child safety is a good example. Google Play adheres to existing ratings, like content ratings for Apps and Games[37], and has built tools to help developers tailor their apps to different age-groups.[38] In 2020, we made additional investments in child safety by creating a Kids 'tab' within the Google Play Store that includes 'Teacher Approved' content.[39] As the ecosystem evolves, we will make sure that these safeguards evolve along with it.

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[34] Why The Gaming Industry Could Be The New Social Media,Matt Schmidt, March 16, 2021 https://www.forbes.com/sites/forbesbusinesscouncil/2021/03/16/why-the-gaming-industry-could-be-the-new-social-media/?sh=33528e938f3a
[35] Device compatibility overview, https://developer.android.com/guide/practices/compatibility
[36] Modular System Components, https://source.android.com/devices/architecture/modular-system
[37] Apps & Games content ratings on Google Play, https://support.google.com/googleplay/answer/6209544
[38] Manage target audience and app content settings, https://support.google.com/googleplay/android-developer/answer/9867159
[39] Find high-quality apps for kids on Google Play, Mindy Brooks, General Manager, Kids and Family, April 15, 2020 https://blog.google/products/google-play/teacher-approved-apps/

4. How should web apps (browser-based) or other apps that operate on a mobile middleware layer be categorized?

The study should include web apps and Progressive Web Apps (PWAs) because they provide a major avenue for developers to reach potential users across different devices and platforms. They also enable high-quality, secure experiences across devices. For example, if someone uses Chrome across their devices, the web apps running within Chrome benefit from security and productivity features like password managers and autofill that may not be available to native apps.

Android provides extensive support for web apps. We've made it easy for Android users to access web apps from their devices' home screens, we do not impose any restrictions on which browsers can be used to access web apps, and we enable any web browser to use the browser-engine of their choice on Android. The ability to use any browser engine (the core software that enables a browser to function) is particularly significant for web apps because the engine powering the app determines how developers can innovate and compete on key features. As a result, Android has higher functioning web apps and offers greater choice for both developers and users.

Our investments on Android, combined with multi-company programs like Project Aurora[40] and Project Fugu[41] have enabled web apps (including both "regular" web apps and PWAs) to become a viable and attractive alternative to providing apps via the Play Store or alternative Android app stores. For example, Twitter, Uber, Nvidia, and more recently, Wordle (which did not start out with or as a native app), have all launched very successful web apps on Android.[42]

By contrast, PWAs—and the web writ-large—receive a small fraction of this support on iOS. This is primarily because of Apple's requirement that all browsers use its proprietary WebKit browser engine.[43] Not only does this prevent browsers from differentiating from Safari—Chrome is unable to access the user's camera, preventing users from using products like Google Lens—it also harms user security. A recent study from Google's Project Zero security research team found that WebKit is significantly slower than other browser engines to fix reported bugs.[44]

5-6. There are some indicators that there is a difference in kind between some apps that generate large amounts of money or are downloaded often and most other apps. For

[40] Introducing Aurora: A collaboration between Chrome and open-source web frameworks & tools, Shubhie Panicker, Addy Osmani, Houssein Djirdeh, June 15, 2021 https://web.dev/introducing-aurora/
[41] Web Capabilities (Project Fugu), https://www.chromium.org/teams/web-capabilities-fugu/
[42] CMA Mobile Ecosystems Market Study Google's Comments on the CMA's Interim Report, February 7, 2022 https://assets.publishing.service.gov.uk/media/6229ac568fa8f526d0002b05/Google.pdf
[43] App Store Review Guidelines, https://developer.apple.com/app-store/review/guidelines
[44] A walk through Project Zero metrics, Ryan Schoen, February 10, 2022 https://googleprojectzero.blogspot.com/2022/02/a-walk-through-project-zero-metrics.html

example, one industry analyst reported that 97% of publishers that monetize through the Apple App Store earned less than $1 million per annum in 2021, compared to other reports of more than $1 billion earned by the top 13 apps (including games) on both Apple and Google platforms. What is the best way to assess the competition environment for less popular apps and start-ups? a. Can any potential harms, such as deficiencies in data security and privacy protections, be traced back to the current market imbalance? b. Is there evidence to suggest that consumers are less likely to avoid or stop using a particular app even if they would prefer a more privacy enhancing environment because of a lack of competitors offering similar services? What unique factors, including advantages and obstacles, are there generally for app development — especially start-ups — that are relevant for competition? a. Are there unique market dynamics in this ecosystem (such as the existence of a small number of dominant technology companies) that affect mobile apps' ability to secure funding? b. Are some methods of monetization essential to the economic success of an app? What are they? For example, is there pressure to incorporate advertising or collect personal data of users or engage in unique relationships with data aggregators?

All developers were small at one point, and whether they've grown steadily, or explosively—for example, as Zoom has during the pandemic—our goal has always been the same. We provide developers with the same resources and opportunities to reach consumers and build successful businesses on Android.

Developers can distribute their apps to more than 2.5 billion users, in over 190 countries and use Google Play's tools to test and launch apps, grow and monetize their audiences, and improve the overall quality of their app experience. We constantly engage with developers, listen to their feedback, and create new ways to support them. Our new Play Partner Program for Games is one example of an effort to provide game developers with additional features and insights to help grow their businesses.[45]

Google Play's business is constantly evolving. In recent months, we moved away from one-size-fits-all pricing to a more tailored approach that accounts for the variety of different business models across the app ecosystem. We reduced our service fees from 30% to 15% for all developers on their first $1,000,000 of revenue,[46] from 30% to 15% of revenue for developers in certain industries that invest in product excellence while in the Play Media Experience Program[47], and from 30% to 15% of revenue for all subscription services. E-books and on-demand music streaming services, where content costs account for the majority of

[45] Google Play Partner Program for Games, https://play.google.com/console/about/programs/partnerprogram/
[46] Boosting developer success on Google Play, Sameer Samat, March 16, 2021 https://android-developers.googleblog.com/2021/03/boosting-dev-success.html
[47] Continuing to boost developer success on Google Play, Purnima Kochikar, June 23, 2021 https://android-developers.googleblog.com/2021/06/continuing-to-boost-developer-success.html

sales, can be as low as 10% of revenue.[48] Because of these reductions, 99% of developers qualify for a service fee of 15% or less, and 97% pay nothing at all.

We also are the only major app store piloting true user choice billing where developers can choose to offer their own payment systems alongside Play's. We recently announced a pilot to invite developers to help us test and iterate on user choice billing in other markets outside South Korea.[49] We started with Spotify as our first partner as they have made substantial investments in the platform, and we're actively looking to add more partners in the coming months.

Software and Support for Developer

7. Are there particular obstacles preventing more development from different communities, such as by location/region, ethnicity/race, language, or gender?

Leveling the playing field and making technology more affordable and accessible to everyone is at the heart of Android's mission. Consumers can buy a top-of-the line Android smartphone for $1,000 and a high-quality device for under $100. With a range of devices available at different prices, Android has helped democratize access to the internet and the benefits of smartphones, making it easy for everyone to access digital content. In 2018, the Joint Center for Political and Economic Studies remarked, "[p]ut simply, Android is one of the few affordable phone options for cost-conscious consumers. Whereas many Apple models cost around $400, individuals can easily find Android smartphones for just $100. That has been extremely helpful for people with fewer resources."[50]

Developers thrive when they're able to collaborate and share ideas with their peers. We've invested for many years in developer outreach programs, and have several that are focused on underrepresented groups in the developer community. Women Techmakers[51], an initiative focused specifically on women in the tech community, and our Accelerator program for Black Founders[52] are two of many examples. Our broader digital skills and business development program, Grow with Google, helps address these issues as well.

8. Are there studies or specific examples of the costs or advantages for app developers to build apps for either, or both, of the main operating systems, iOS and Android (which have different requirements)? a. What are the challenges specific to multi-platform

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[48] Evolving our business model to address developer needs, Sameer Samat, October 21, 2021 https://android-developers.googleblog.com/2021/10/evolving-business-model.html
[49] 'Exploring User Choice Billing With First Innovation Partner Spotify', Sameer Samat, March 23, 2022 https://android-developers.googleblog.com/2022/03/user-choice-billing.html
[50] For communities of color, increased smartphone costs mean decreased opportunity, Spencer Overton, August 2, 2018, https://amsterdamnews.com/news/2018/08/02/communities-color-increased-smartphone-costs-mean/
[51] Women Techmakers, https://developers.google.com/womentechmakers
[52] Black Founders, https://startup.google.com/accelerator/black-founders/

development and how can they be mitigated? b. What are the costs and advantages of developing standalone apps for these platforms relative to other means of providing the same services or content, such as web apps, which can operate across platforms?

While many developers build native apps that run on both iOS and Android, Android's openness affords them opportunities and choices that aren't available in a closed ecosystem. For example, developers benefit from the scale of the overall Android ecosystem and the variety of different types of devices powered by Android—smartphones, tablets, TVs, cars, wearables—that people use around the world.

The numerous ways developers can easily distribute their apps also sets Android apart. Android developers can distribute native mobile apps via multiple different app stores and directly to their users. We've also made it easy for them to distribute web apps. Developers can build apps for the browser of their choice, and browsers can use the browser engines of their choosing as well.

9. What role does interoperability play in supporting and advancing a competitive mobile app ecosystem? a. What are the key characteristics of interoperability as it relates to the mobile app ecosystem? b. What other barriers (*e.g.,* legal, technical, market, pricing of interface access such as Application Programing Interfaces [APIs]) exist, if any, in fostering effective interoperability in this ecosystem? How are these barriers different or similar than those present in other ecosystems? c. How does data portability, or lack thereof, factor into consumers keeping the same app if they switch from one operating system (iOS or Android) to another?

Interoperability and data portability help increase competition and consumer choice. When competing digital services are compatible or interoperable with each other, there is less friction and consumers can more easily choose between and among competing services. The same goes for data portability. Giving consumers the ability to move their data from one service to another reduces friction and "switching cost," while expanding choice.

With respect to the mobile ecosystem in particular, basic text messaging is the clearest and most familiar example of interoperability. Virtually every user with a phone can communicate via SMS texting, and despite being nearly 30 years old, the mobile industry has yet to abandon the SMS standard.

Texting's universal interoperability, however, is at risk. The slow evolution of text messaging combined with the popularity of Over The Top (OTT) messaging apps like WhatsApp or Signal have enabled millions of users to communicate across mobile platforms—but only within their respective apps. For instance, a Signal user could send a message from an Android to an iPhone, but not to Facebook Messenger.

There is already a solution to this problem that has broad support from mobile carriers around the world. Rich Communication Services (RCS) is a new standard and will both modernize texting and preserve the interoperability that has made it such a useful tool. RCS enables a variety of different features that SMS doesn't: better exchanges of rich media like photos and video, read receipts, and vastly improved security protections like end to end encryption. To encourage adoption of RCS, we've built our own RCS enabled texting app, Google Messages, which is now the default messaging client on T-Mobile, Verizon, and AT&T devices in the US. [53]

However, a major obstacle to widespread adoption of RCS has been Apple's decision not to adopt it in iMessage; their proprietary OTT app that is only available on iPhones. Documents from the Epic v. Apple lawsuit show their reluctance is based on the fear that implementing RCS would remove a barrier that keeps consumers locked into Apple's ecosystem. As Apple's Phil Schiller writes in a 2013 email: "I am concerned the iMessage on Android would simply remove [an] obstacle from iPhone families giving their kids Android phones." [54]

When iMessage users text Android users, they are forced to do so via SMS. As a result, the experience is poor—dropped messages, fuzzy photos and videos are common—and security protections are weak, for Apple and Android users alike. Because SMS messages cannot be encrypted and travel in the clear, their contents are easily viewable if they're intercepted. This could pose a variety of privacy risks, including illegal access to a user's account via a two-factor authentication code sent in an SMS text. Leading consumer tech analyst Marques Brownlee outlines these issues in a simple explainer that now has more than 4 million views on YouTube. [55]

If iMessage adopted RCS as the standard for messages between Androids and iPhones, the overall quality and security of the mobile ecosystem would improve for everyone. RCS has widespread support and Apple making this change would be a significant step forward for mobile interoperability and user safety.

In addition to messages, the study should also account for the importance of mobile web browsers. Browser engine interoperability helps improve competition in mobile ecosystems and evolve the open web as a whole. On Android, developers can use any browser engine to build their browsers, and users can use the browser of their choice.

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[53] Verizon is also switching to Android Messages as default for RCS, Dieter Bohn, July 20, 2021, https://www.theverge.com/2021/7/20/22584443/verizon-android-messages-rcs

[54] Email from Phil Schiller to Craigh Federighi, Eddy Cue, Tim Cook, April 8, 2013, https://embed.documentcloud.org/documents/21043920-2013-april-federighi-and-schiller-tell-cue-not-to-bring-imessage-to-android-lockin/#document/p2

[55] Blue Bubbles vs Green Bubbles: Explained!, Marques Brownlee, https://www.youtube.com/watch?v=BuaKzm7Kq9Q

On Apple's mobile operating system, all browsers are required to use Apple's WebKit engine, limiting the functionality of non-Apple browsers and web apps. For example, while Safari can access an iPhone user's camera, Apple does not share the necessary APIs to allow other browsers to use this feature. If this weren't a restriction in the WebKit engine, other browsers could add visual search or other products that attract users.

Apple's decision to require WebKit as the only browser engine on iOS affects user security as well. Researchers found that Apple's browser engine is significantly slower than other browser engines to fix reported bugs, making users less safe when using browsers on iOS because they have no ability to use another browser engine.[56]

10. While apps can be coded from scratch, Software Development Kits (SDKs) and other technical tools can make it easier for developers to create apps. What data is available to show how such tools shape the ecosystem and affect the ability of developers to compete? Which tools are most often used by app developers and what are the entities that offer those tools? b. Do these tools make it easier for a developer to create apps for multiple platforms? How so? Are there any trade-offs (*e.g.,* performance, battery life, or stability) for using these tools? c. Are developers of certain types of apps more likely to use the assistance? d. Are there privacy or security concerns associated specifically with these tools? e. What empirical data exists to support findings on this topic? a. Which tools are most often used by app developers and what are the entities that offer those tools? b. Do these tools make it easier for a developer to create apps for multiple platforms? How so? Are there any trade-offs (*e.g.,* performance, battery life, or stability) for using these tools? c. Are developers of certain types of apps more likely to use the assistance? d. Are there privacy or security concerns associated specifically with these tools? e. What empirical data exists to support findings on this topic?

Whether it's a smartphone, smart TV, game console, or smartwatch, SDKs are the fundamental tools that developers use when they create an app. Developers use SDKs to ensure their apps function on various platforms, create new features on top of widely-used services like Google Maps, build their businesses with analytics and advertising, and lots more. Apps often use multiple SDKs, and a single SDK's behavior may affect thousands of different apps.

From a competition standpoint, SDKs help drive innovation because they save developers the incalculable time and money that would be needed to code interactions between their apps and a platform from scratch. Consider an incredibly basic example like designing a button within an app. Without a platform's SDK, developers would need to know how to code the button's location and then update the code if they choose to move the button elsewhere. They'd then have to do the same thing, but with different code, for every other platform. By

[56] A walk through Project Zero metrics, Ryan Schoen, February 10, 2022, https://googleprojectzero.blogspot.com/2022/02/a-walk-through-project-zero-metrics.html

simplifying this process, not only does the speed of innovation increase, but the pool of talent that can participate in the app development process grows as well. More people, with less technical expertise, can build and launch an app to reach users on smartphones, TVs, game consoles, wearables, and more.

SDKs can present some challenges from a privacy standpoint. Platforms often don't have visibility into how data is used after an SDK has collected it, and as a result, taking action on bad actors is difficult. Relatedly, app developers may be unaware of an SDK's data practices. For example, they may be using an SDK for legitimate business analytics (to analyze customer acquisition and churn, for example) only to later learn that the SDK provider was packaging this data and selling it. Frustratingly for app developers, this activity—which they aren't aware of—would cause them to run afoul of Play's user data policy which prohibits the sale of personal and sensitive data. Google Play would take action on the app because of this policy violation.

This was the case in recent months with SDKs acting as brokers for location data. After careful analysis of many actors in this space, we took action to prohibit app developers on Play from working with several SDKs, including X-Mode, SafeGraph, and Predicio, because they caused apps to violate our policies prohibiting the sale of user data.[57] The action on X-Mode was noted by policymakers, including Senator Ron Wyden[58] and FTC Commissioner Wilson[59].

We are committed to improving security and transparency in the SDK ecosystem and we recently introduced a product called the Google Play SDK Index with this goal in mind.[60] Google Play SDK Index is a new public portal that lists more than 100 of the most widely used commercial SDKs and provides insights about each one, such as: the Android app permissions the SDK may request, whether the SDK provider is committed to ensuring that their SDK's code follows Google Play policies, retention metrics, and more. It's early days for this tool and we look forward to receiving feedback from developers, and the broader mobile ecosystem.

11. How do policy decisions by firms that operate app stores, build operating systems, or design hardware impact app developers (*e.g.*, terms of service for app developers)? What empirical data exists to support those findings? a. In particular, how does a lack of transparency about app market rejections affect app developers (*e.g.*, costs)? b. How do the policy decisions affect or limit the feasibility or availability of alternative models of

[57] https://support.google.com/googleplay/android-developer/answer/10144311
[58] Apple and Google to Stop X-Mode From Collecting Location Data From Users' Phones, Byron Tau, December 9, 2020
https://www.wsj.com/articles/apple-and-google-to-stop-x-mode-from-collecting-location-data-from-users-phones-11607549061
[59] FTC Commissioner Christine Wilson, December 10, 2020
https://twitter.com/CSWilsonFTC/status/1337118742543679489
[60] New Google Play SDK Index helps you choose the right SDKs for your app, Yafit Becher, Product Manager and Ray Brusca, Strategic Partnerships Manager, May 11, 2022,
https://android-developers.googleblog.com/2022/05/new-google-play-sdk-index.html

app development (*e.g.* open source), delivery (*e.g.* browser-based apps), or funding (*e.g.* non-commercial or donation-based models)?

Google Play's policies help us share apps and games safely to billions of people worldwide. In 2021, we blocked 1.2 million policy-violating apps from being published on Google Play, preventing billions of harmful installations. We also continued in our efforts to combat malicious and spammy developers, banning 190,000 bad accounts, and closed around 500,000 developer accounts that are inactive or abandoned.[61]

At their heart, the purpose of the policies we have developed over many years is to build an app store that is trusted, dependable, and offers a great experience for all parties involved. That means deeply researching our policies and consulting third-party experts about the issues they govern, displaying the policies publicly and in plain language that anyone can understand, and communicating about enforcement so that users and developers alike recognize how seriously we take our policies and that there are repercussions for violations. When developers violate our policies we take action. We contact them and clearly describe what in the app caused the violation, including screenshots where appropriate, and provide a way for developers to easily appeal the decision if they believe the decision was in error. The actions we may take include: removing, suspending, or limiting the visibility of an existing app, and terminating a developer's account.[62]

The trust that our policies have established is helpful to developers as well. Without it, fewer people would use the store and developers' potential audiences would shrink. We strive to be as transparent as possible about our policies and we share updates about them on a regular basis.[63]

12. What types of labor restrictions or workforce pipeline challenges, if any, limit paths for app innovation? What may solutions look like?

Providing more access to tools that help developers build their businesses has been a focus since the earliest days of Android. Less than a year after it got off the ground, we held our first Google I/O developer conference and hosted a variety of seminars for developers building on Android and other platforms.[64] We continue to host this conference every year and share videos from sessions online so that all developers can learn from them.

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[61] How we fought bad apps and developers in 2021, Steve Kafka and Khawaja Shams, Android Security and Privacy Team, April 27, 2022, https://security.googleblog.com/2022/04/how-we-fought-bad-apps-and-developers.html
[62] Enforcement Process, https://support.google.com/googleplay/android-developer/answer/9899234
[63] Updates to Google Play Policies, https://support.google.com/googleplay/android-developer/answer/9934569
[64] 2008 Google I/O Session Videos and Slides, https://sites.google.com/site/io/

Beyond Android, we've invested for many years in programs like Grow with Google that help businesses improve their presence online and offer trainings and professional certificates to anyone that wants to develop digital skills.[65] We are now providing $100,000 worth of online courses in data analytics, web design, and other tech-related skills to any business in the United States, free of charge.

Avenues for App Distribution

13-14. Some mobile apps are pre-loaded on mobile devices or set as default apps, while others are only available through an app store, through a browser (web apps), or, for devices using the Android system, by sideloading. Is there data comparing these mechanisms and their effect on app distribution? As noted above, governments and courts are already exploring concerns about control of app access to users exercised by mobile app stores and other ecosystem participants. a. What data and studies exist that identify specific additional obstacles that developers and businesses might face related to the distribution of apps? [31] Commenters may reference factual findings in existing cases and filings in government explorations.[32] b. In particular, what studies have been done on requirements that apps use an app store or operating system's own services or the appeal of alternative mechanisms that do not tie app access to using other products or services from those mechanisms?

There are a variety of different ways apps may be installed on Android devices.

First, Android users can download apps themselves from a variety of different app stores including Google Play, Samsung's Galaxy Store, Amazon Appstore, and others. The overwhelming majority of Android devices come pre-installed with more than one app store, and because there's no such thing as a default app store on Android, Android users can use multiple app stores at once. As of February 2022, the top 3 most downloaded mobile apps on Android were: Instagram, Snapchat, and TikTok[66] and the typical Android user will choose to install around 50 apps.[67]

Mobile apps may also come pre-installed on devices. A typical Android phone comes preloaded with as many as 40 apps from multiple developers, not just from the company that provided it. Negotiations between device manufacturers and app developers for pre-installation are highly competitive. On Android, device manufacturers can select which apps and app stores they would like consumers to have installed on the device "out of the box." Manufacturers can monetize this channel through pre-installation deals with app developers.

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[65] Grow with Google, https://grow.google/
[66] Leading Android apps in the Google Play Store worldwide in February 2022, by number of downloads, https://www.statista.com/statistics/693944/leading-android-apps-worldwide-by-downloads/
[67] Android has created more choice, not less, Sundar Pichai, CEO, July 18, 2018 https://blog.google/around-the-globe/google-europe/android-has-created-more-choice-not-less/,

They can also use it to distribute their own apps and app stores. Manufacturers can—and do—install their own apps prominently on devices' home screens. For example, Samsung pre-installs the S-Browser and places it prominently on the home screen, whereas several major app developers have signed pre-installation deals with device manufacturers—Facebook (for its Instagram and Facebook apps), Spotify, and Microsoft (for its Microsoft Office suite of apps, and LinkedIn). These developers' abilities to distribute native apps outside of Play constitutes a clear competitive advantage.

Google offers phone makers the option of preloading a suite of popular Google apps (such as Search, Chrome, Play, Maps and Gmail), which help ensure the phone 'just works', right out of the box. Phone makers don't have to include our services and they're also free to pre-install competing apps alongside ours. On Apple's devices, the number of pre-installed Apple apps is greater than the number of Google apps on Android, and Apple doesn't pre-install any third-party apps at all.

15-16. How do, or might, alternative app stores (other than Google Play or the Apple App Store), affect competition in the mobile app ecosystem? a. What data is there to assess how well existing alternative stores distribute apps, in general or specific types of apps? b. What unique barriers are there affecting each of the main operating systems (Android, iOS) that might prevent web apps or—to the extent allowed on Android system—alternative app stores and sideloading, from gaining more popularity with users and app developers than they currently have? c. Is there analysis comparing competition on iOS ecosystem (where app distribution is limited) to that of alternative distribution mechanisms on Android operating systems?

Android enables users to download apps from many different stores which offer hundreds of thousands, if not millions, of apps. Samsung, the largest manufacturer of Android smartphones, pre-installs the Galaxy Store on all Samsung smartphones. These app stores compete strongly with the Play Store for both developers and users, for example through special offers.

For their parts, developers can choose whether to promote their apps only on Google Play, only on a third-party app store, or on multiple Android app stores. This competition has also led to targeted efforts by app store providers to attract individual developers, such as Samsung pursuing exclusivity deals for its Galaxy Store with Epic Games, Riot Games, and Activision Blizzard.[68] In most cases, developers do not have to (re)develop an app for a new OS, as the vast majority of alternative Android app stores run on compatible versions of Android. App store providers must therefore compete across several metrics to attract and retain developers. This has led to continuous efforts to make it easier for apps to be developed for

[68] CMA Mobile Ecosystems Market Study, Google's Comments on the CMA's Interim Report, February 7, 2022, https://assets.publishing.service.gov.uk/media/6229ac568fa8f526d0002b05/Google.pdf

different systems, which in turn has lowered technical and financial costs for developers. For example, developers can use cross-platform development tools such as Flutter to create apps that are able to run on multiple OSs.

The study should apply a critical eye to the term 'sideloading' and how it's being used in mainstream conversation to suggest that any app that's been downloaded outside of a platform's primary app store is unsafe. Unlike on iOS where there is only one way to download mobile apps, there are many reputable, safe stores from which people download Android apps every day. Equating a download from one of these established stores with a download directly from a developer's (likely less secure) website advances the misleading narrative that choice comes at the expense of user safety. This is a false choice: Android users can choose to download apps from a variety of different sources because multiple layers of security protections keep them safe.

Apple tries to make the debate around competition in connected device ecosystems about sideloading. Ultimately, this is a sliver of the story, and not just from a security standpoint. Open ecosystems offer choices that are unavailable elsewhere, which has led to more competition, lower prices, and greater availability of different software. Even Epic Games, one of Apple and Google's most vocal critics, is able to distribute titles like Fortnite on Android.

17. Mobile app stores act as initial screeners and responders for concerns about mobile app content, such as fraudulent apps and malware.[33] Similar issues for screening and responding exist in other contexts, such as website hosting and search engine retrieval. What empirical data is there analyzing any unique content screening issues related to mobile app stores that affect competition? a. Is there evidence of legitimate apps being rejected from app stores or otherwise blocked from mobile devices? Is there evidence that this is a common occurrence or happens to significant numbers of apps? b. What assessments are there of their effectiveness, or lack therefore, on security and privacy of end users? c. Are there disincentives or unique barriers affecting the degree of security and privacy protections offered by alternative app stores?

The safest way to install apps and games on an Android device is from a reputable app store. In our view, Google Play is the safest way for Android users to install apps and games. But we also believe that users should have choices, including installing apps directly from a developer, and that safety should inform users' choices about where to find apps and games.

We recently launched a Data safety section for apps in the Play Store, empowering users to make privacy-conscious app installation decisions.[69] This section requires developers —including Google — publishing apps on Play to outline important privacy and security information about the app including: the types of data it collects, the types of data it shares

[69] Get more information about your apps in Google Play, Suzanne Frey Vice President, Product, Android Security and Privacy, April 26, 2022 https://blog.google/products/google-play/data-safety/

with third parties, and whether that data is encrypted in transit by the developer. Additionally, developers will have the option to have their apps independently validated against a global security standard and showcase that on their Data safety section.

For closed platforms, "security" sometimes means taking choices away from users and restricting what they can do with their devices. Our approach is different. We have developed layers of security to help protect users from potentially harmful apps, plus other risks like network exploitation and phishing, while also allowing users to take advantage of the benefits of openness. We build protections into the core operating system, and we continually scan devices for malware and other harmful behavior. Before users install an app from an unknown source, we remind the user to consider the risk. Then, if the user knows and trusts the developer, they can proceed. This is common sense and something that many platforms, like Windows and MacOS, do. Our approach has meant that Android users enjoy an overwhelmingly safe experience: we scan more than 125 billion apps each day.

18. Are there other areas, specific technologies or procedures, that offer lessons on more and less successful ways to screen out problematic apps? What are the characteristics of such success? a. Are there good examples by enterprise users? b. For example, some devices allow sideloading only after warning the user to make sure they trust the app before proceeding with the download, in a way similar to how some browsers issue warnings for unknown websites. What material exists about the efficacy of such methods c. What roles, if any, do independent or third party security testing play in the app store ecosystem? d. Does the current model discourage competition and innovation in the development or advancement of security testing?

Taking action against harmful apps fosters an ecosystem that is safe for users and developers, growing innovation and competition. We regularly share updates about this work.

In a recent blog post, we reported that in 2021 we blocked 1.2 million policy violating apps from being published on Google Play, banned 190,000 bad accounts, and closed around 500,000 developer accounts that are inactive or abandoned.[70] We also frequently update our Android ecosystem security report: as of December 2021, 0.086% of all Android devices had a potentially Harmful App on the device and on enterprise devices the figure was 0.005%.[71]

Security protections like Google Play Protect, which scans more than 125 billion installed apps per day, will detect and take action on these apps. If Play Protect detects a Potential Harmful App (PHA), it displays a warning. In some cases, it automatically disables or removes the app.

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[70] How we fought bad apps and developers in 2021, Steve Kafka and Khawaja Shams, Android Security and Privacy Team, April 27, 2022
https://security.googleblog.com/2022/04/how-we-fought-bad-apps-and-developers.html
[71] Android ecosystem security,
https://transparencyreport.google.com/android-security/device-platform-safety

When Play Protect detects that a PHA contains features from multiple categories, it classifies the app based on the most harmful characteristics. For example, if an app applies to both ransomware and spyware categories, the Verify Apps message identifies it as ransomware.

Similar warnings exist across major software platforms and web browsers including: MacOS[72], Windows[73], Safari[74], Firefox[75], Microsoft Edge[76], and Chrome[77]. These warnings help users make informed choices and improve consumer's experiences.

19. How does the existence of imposter and other fraudulent apps affect developer incentives or legitimate app lifecycles?

See response to question 18.

App Users

20. What research exists regarding the number of active apps consumers have on their mobile devices at any one time and how often they try new ones? a. Are there generalizations that can be made based on items such as the cost of the app, type of broadband access or device, or even categories of phone users?

See response to questions 13 -14.

21. How do most consumers find and make decisions to use apps? a. Is there data to show whether the usage of an app or any other relevant metric for performance is tied to existing brand visibility outside of the mobile app ecosystem? b. Is there data about how often people use the search feature in an app store, search engines through browsers, or particular ranking lists of popular apps or app storefronts? c. Is there empirical data that examines how app rankings, app reviews, or other objective measures of apps (for example, popularity, quality, or number of downloads) are used (or manipulated) to influence consumer choices?

Before downloading them, users find apps in a variety of ways such as discovering them within app stores or developing an interest in them. The app may come up in conversation with

[72] Safely open apps on your Mac, https://support.apple.com/en-us/HT202491
[73] Open file Security Warning, https://answers.microsoft.com/en-us/ie/forum/all/open-file-security-warning/5add01b0-7663-4524-b8e8-21e1f706da83
[74] Download items from the web using Safari on Mac, https://support.apple.com/guide/safari/download-items-from-the-web-sfri40598/mac
[75] Where to find and manage downloaded files in Firefox, https://support.mozilla.org/en-US/kb/where-find-and-manage-downloaded-files-firefox#w_download-protection
[76] Learn how Microsoft Edge handles mixed content downloads, https://docs.microsoft.com/en-us/deployedge/edge-learnmore-mixed-content-downloads
[77] Manage warnings about unsafe sites, https://support.google.com/chrome/answer/99020

friends, it may be covered on the news, or it may become a meme on social media and gain popularity incredibly quickly.

In Google Play, consumers can discover apps in a variety of different ways: searching for specific apps or categories of apps using the search feature, discovering apps through personalized recommendations based on previous downloads, and discovering apps featured on Google Play home pages.

Users may choose to download apps for any number of reasons. Google Play focuses on showing users relevant, high quality apps and sharing helpful information about the apps to facilitate the browsing and downloading experience. Users can see the number of installs, average star rating, and text reviews for apps in Google Play. Users can also see the relative popularity of some types of apps through clusters such as "Top Charts" which showcase the most popular apps and content in certain categories based on relevant information like the total number of installs. Google Play has general data about how often the search feature is used and how often users interact with certain surfaces in the store.

22. The E.O. asks the Department to explore ways to maximize "user benefit" with regard to competition in the mobile app ecosystem. How should we measure or consider user benefit? a. What is the appropriate scope of users for consideration? Should it include developers? b. If there are conflicts between end-user and developer interests, how does this affect the assessment of user benefit? c. How might convergence of end-users and developers—through low-code environments, for example—affect this dynamic moving forward?

The study should take a broad view of the value the app ecosystem has created for the diversity of parties that comprise it. At the most basic level, that includes the well-known trio of parties that comprise the ecosystem—hardware manufacturers, app developers, and end users. But, it should consider these in the context of the value that apps have brought to the economy as a whole.

Outside of technology circles, the idea that billions of people would be walking around with a small device that would enable them to pay for coffee with a tap, provide driving directions instantaneously from anywhere, help anyone take professional grade photos without expensive equipment, and enable a car to appear in front of them with a few taps on a screen was straight out of science fiction. But that is exactly what's happened.

While the app ecosystem may have developed around an entirely new device—the smartphone—today, it has evolved to transform how people use the devices that existed long before 2007 when the iPhone and Android were first introduced. The app ecosystem has changed the way consumers use their TVs and video game consoles because they expect to have similar experiences across all of their screens. In other words, the study should not

overlook the value generated by the app ecosystem for technologies that aren't necessarily mobile.

Other Factors

23.Do apps that are developed for, or used by, certain communities (such as by income, ethnicity/race, or gender) face significantly different competitive challenges? What are the challenges?

Apps developed for certain communities may have different competitive challenges, including that broadband internet may not be available or affordable in these communities. While various data plans may attempt to address this issue on smartphones, the same can't be said for accessing apps on devices like game consoles or PCs. Congress recently approved $65 Billion to invest in broadband infrastructure to enable ISPs to reach all Americans. See also response to question 7.

24. Some apps make use, or would like to make use, of additional mobile device components beyond those that are more commonly accessible (*e.g.*, camera, microphone, contacts) in order to offer an innovative product or service, but the operating system or device provider does not allow such access. Similarly, for some apps, it might be essential to be able to interconnect to other hardware and services, such as cloud services. What are the valid security concerns and technical limitations on what device functionality an app can access? a. What factors should be considered in striking a balance between encouraging companies to ensure proper security measures, while allowing third parties to access the protected features that might allow for further innovation and competition? b. Are there specific unnecessary (*e.g.*, technical) constraints placed on this ability of app developers to make use of device capabilities, whether by device-makers, service providers or operating system providers, that impact competition? c. Are there other means or factors to consider for mitigating specific risks that would not inhibit competition?

With each new release of Android, we work to improve our privacy and security features. Taken individually, they may appear as a running list, so it's important to outline the principles behind the features we've built.

Transparency has always been a core tenet of privacy and security on Android. We want people to understand their data so they can make informed decisions. In Android 12, we added a new indicator to the top right of the status bar on Android devices so users know when apps are accessing a device's microphone or camera. New toggles in Quick Settings[78] enable users

[78] Android 12 Beta: Designed for you, Sameer Samat,VP of Product Management, Android & Google Play, May 18, 2021 https://blog.google/products/android/android-12-beta

to remove all apps' access to these sensors for the entire system. The previously discussed Data safety section and privacy dashboard are relevant examples as well.

The importance of context is reflected in Android's privacy and security features as well. For example, 'Runtime Permissions'[79] require developers to ask users for access to the device's camera, its microphone, and location data, among other things, before they begin to use the app. This helps users understand how and why an app would use the data in the moment, and then enables them to make the personal decision about whether or not to use the app. These are flexible and updatable at any time: users don't have to make decisions that affect them in perpetuity

More broadly, permissions help create healthy habits that should permeate the connected device ecosystem as a whole, especially because approaches to privacy may differ across devices. For example, a parent may feel comfortable providing apps with access to certain tools and data on their personal smartphone, but may feel differently on a device like a gaming console that is shared with the entire household. They should be able to make their choices as needed, at any time.

25. What unique challenges, if any, do software updates pose for app competition, including updates driven by the app developers and those necessitated by other ecosystem changes, such as operating system updates? How does this impact security and costs for those apps, products, and services?

As an open platform with many stakeholders—OEMs, carriers, multiple device varieties, and more—it can be difficult for the ecosystem to move in concert and incorporate security updates quickly. We have long recognized this challenge and have made a variety of technical changes to improve this process.

Over the last several years, we've focused on making it less burdensome for our ecosystem partners to publish—and both easy and affordable for users to receive—security updates for their devices. These efforts have been successful. As of Q4 2021, nearly 90% of all Android models launched within the last 24 months with at least 100,000 monthly active devices had a 90-day or newer declared security patch level.[80] App and OS updates can also keep devices usable for longer, increasing the monetary value users get out of them.

[79] Request app permissions, https://developer.android.com/training/permissions/requesting
[80] Android ecosystem security, https://transparencyreport.google.com/android-security/device-platform-safety?hl=en

In Android 8, we introduced Project Treble[81], which enabled partners to update their devices faster. With Android 10 we launched Project Mainline[82], which allowed additional critical components[83] such as media and connectivity to be updated through Google Play instead of as part of a larger platform software update. These technological improvements in recent years have enabled partners to publish security updates, and upgrade devices to newly released OS versions, faster than ever before. We report these statistics publicly through our blog posts[84] as well as within our Android ecosystem security Transparency Report[85], and we're always looking for ways to work with our OEM and carrier partners to continue to raise the bar.

As part of our ongoing efforts to improve the security of Android devices, in 2019 we also added expiration dates for our approval of devices that come with Google's apps preloaded. After a set period of time, approval for a specific version of a device's firmware image will expire, and those images may no longer be used on new devices. In rare cases, OEMs can sell their existing inventory.

26. Are there governance practices, regulations or laws that impact competition among certain categories of apps more than others, or their non-app counterparts?

When it comes to messaging and communication apps, common standards or protocols are of particular importance to ensure choice and competition. Where users of one messaging platform are unable to safely engage with those on another platform, they (and their contacts) may be induced to stay "locked-in" with their existing platform. This reduces consumer choice and insulates the existing platform from pro-consumer competitive pressures. NTIA should consider convening a multistakeholder process to incentivize adoption of common standards or protocols and general best practices in interoperability.

In some cases, certain mobile data practices may have the potential to limit consumer choice and competition among and between apps in the mobile app ecosystem, including particular ways in which mobile carriers may impose data caps or zero rating plans. Depending on those practices, consumers may be precluded or limited in the number of apps they use.

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[81] Here comes Treble: A modular base for Android, Iliyan Malchev, Project Treble team lead, May 12, 2017, https://android-developers.googleblog.com/2017/05/here-comes-treble-modular-base-for.html,.
[82] Fresher OS with Projects Treble and Mainline, Anwar Ghuloum, Engineering Director and Maya Ben Ari, Product Manager, Android, May 8, 2019, https://android-developers.googleblog.com/2019/05/fresher-os-with-projects-treble-and-mainline.htm
[83] Modular System Components. https://source.android.com/devices/architecture/modular-system#available-modules
[84] Accelerating Android Updates, Eddie Hsu (Technical Program Manager), Brent VerWeyst (Product Manager), Maya Ben Ari (Product Manager), Amith Dsouza (Technical Account Manager), Iliyan Malchev (Project Treble Architect), July 9, 2020, https://android-developers.googleblog.com/2020/07/accelerating-android-updates.html
[85] Android ecosystem security, https://transparencyreport.google.com/android-security/overview

Potential Actions To Increase Competition

27-28. What specific measures might the federal government take to foster healthy competition—especially for nascent app innovation—in the mobile app ecosystem? What specific actions could the private sector and civil society take to ensure and promote healthy app competition (such as technical standards development or monitoring)?

Policymakers, private sector, and civil society should work together to ensure that app ecosystem safety does not come at the expense of choice for users, developers, and handset makers. This includes Congress passing a baseline federal privacy law.[86] As we shared with the NTIA in 2018 (in response to the agency request for comment on "Developing the Administration's Approach to Consumer Privacy"),[87] Google firmly believes that federal legislation is the best path to realize NTIA's goals, and reaffirms our long-standing support for smart and strong comprehensive baseline privacy legislation that enshrines high standards of privacy for everyone.

Processes and policies in this space should be guided by foundational principles that spur innovation, maintain security and expand user choice across the ecosystem, whether on mobile, desktop or gaming consoles. Specifically, those principles should be:

- Consumers should be allowed to download apps and games from anywhere — operating systems should support multiple app stores and allow consumers to get apps and games directly from developers.
- App stores should keep consumers safe by building protections into the core operating system and requiring app stores and developers to follow high safety standards.
- App stores should be upfront with developers about the rules of the road, enforce policies in a predictable way, work with developers to address problems and offer clear means of appeal and redress when issues arise.
- App stores should permit developers to build direct customer relationships, with reasonable safeguards to protect consumer safety.
- Consumers and developers should be able to use the app store and payment system of their choice.

[86] The urgent necessity of enacting a national privacy law, Kent Walker President of Global Affairs, Google & Alphabet, April 25, 2022 https://blog.google/outreach-initiatives/public-policy/the-urgent-necessity-of-enacting-a-national-privacy-law/

[87] https://www.ntia.doc.gov/files/ntia/publications/google_comments_for_ntia_rfc_on_privacy.pdf